

WHAT IS CLAIMED IS:

1. An embossing system for embossing and perforating at least a portion of a web comprising:
 - a first embossing roll having embossing elements; and
 - at least a second embossing roll having embossing elements, wherein the embossing elements of the first and second embossing rolls define perforate nips for embossing and perforating the web; and
 - wherein at least a portion of the perforate nips are substantially oriented in the cross-machine direction.
2. The embossing system of claim 1 wherein substantially all of the perforate nips are substantially oriented in the cross-machine direction.
3. The embossing system of claim 1 wherein all of the perforate nips are substantially oriented in the cross-machine direction.
4. The embossing system of claim 1 wherein at least a portion of the embossing elements are male elements that are substantially oval shaped.
5. The embossing system of claim 1 wherein at least a portion of the embossing elements are male elements that are substantially hexagonal shaped.

6. The embossing system of claim 1 wherein at least a portion of the embossing elements are male elements that are substantially rectangular shaped.

7. The embossing system of claim 1 wherein the cross-machine embossing elements are at an angle of from at least about 60° to 120° from the machine direction.

8. The embossing system of claim 1 wherein the cross-machine embossing elements are at an angle of from about 85-95° from the machine direction.

9. The embossing system of claim 1 wherein at least a portion of the cross-machine embossing elements are male elements having a height of at least about 15 mils.

10. The embossing system of claim 9 wherein at least a portion of the cross-machine embossing elements are male elements having a height of at least about 30 mils.

11. The embossing system of claim 10 wherein at least a portion of the cross-machine embossing elements are male elements having a height of about 30 to 65 mils.

12. The embossing system of claim 9 wherein at least a portion of the cross-machine embossing elements are male elements having a height of at least about 45 mils.

13. The embossing system of claim 9 wherein at least a portion of the cross-machine embossing elements are male elements having a height of at least about 60 mils.

14. The embossing system of claim 1 wherein the cross-machine embossing elements are in full-step alignment.

15. The embossing system of claim 1 wherein the cross-machine embossing elements are in half-step alignment.

16. The embossing system of claim 1 wherein the cross-machine embossing elements are in quarter-step alignment.

17. The embossing system of claim 1 having a cross-machine element engagement of from about at least 15 mils.

18. The embossing system of claim 1 having a cross-machine element engagement of from about at least 16 to 32 mils.

19. The embossing system of claim 1 wherein the cross-machine embossing elements have angled sidewalls, wherein the sidewalls have an angle of less than about 20°.

20. The embossing system of claim 19 wherein the sidewall angle of the cross-machine embossing elements is less than about 17°.

21. The embossing system of claim 19 wherein the sidewall angle of the cross-machine embossing elements is less than about 14°.

22. The embossing system of claim 19 wherein the sidewall angle of the cross-machine embossing elements is less than about 11°.

23. The embossing system of claim 19 wherein the sidewall angle of the cross-machine embossing elements is from about 7° to 11°.

24. The embossing system of claim 1 wherein at least a portion of the elements have a height of about 30 mils and have an engagement of about 15 mils.

25. The embossing system of claim 1 wherein at least a portion of the elements have a height of about 30 mils and have an engagement of about 24 mils.

26. An embossing system for embossing at least a portion of a web comprising:

a first embossing roll; and

at least a second embossing roll,

wherein each of the first and second embossing rolls has at least one juxtaposable embossing element substantially oriented in the cross-machine direction, thereby defining a cross-machine direction perforate nip between the cross-machine direction elements for embossing and perforating the web, and

wherein at least a substantial portion of the cross-machine direction elements have at least the ends beveled.

27. The embossing system of claim 26 wherein at least a portion of the embossing elements are male elements that are substantially oval shaped.

28. The embossing system of claim 26 wherein at least a portion of the embossing elements are male elements that are substantially hexagonal shaped.

29. The embossing system of claim 26 wherein at least a portion of the embossing elements are male elements that are substantially rectangular shaped.

30. The embossing system of claim 26 wherein the cross-machine embossing elements are at an angle of from at least about 60° to 120° from the machine direction.

31. The embossing system of claim 30 wherein the cross-machine embossing elements are at an angle of about 85° to 95° from the machine direction.

32. The embossing system of claim 26 wherein at least a portion of the cross-machine embossing elements are male elements having a height of at least about 15 mils.

33. The embossing system of claim 32 wherein at least a portion of the cross-machine embossing elements are male elements having a height of at least about 30 mils.

34. The embossing system of claim 32 wherein at least a portion of the cross-machine embossing elements are male elements having a height of at least from about 30 to 65 mils.

35. The embossing system of claim 32 wherein at least a portion of the cross-machine embossing elements are male elements having a height of at least about 45 mils.

36. The embossing system of claim 32 wherein at least a portion of the cross-machine embossing elements are male elements having a height of at least about 60 mils.

37. The embossing system of claim 26 wherein the cross-machine embossing elements are in full-step alignment.

38. The embossing system of claim 26 wherein the cross-machine embossing elements are in half-step alignment.

39. The embossing system of claim 26 wherein the cross-machine embossing elements are in quarter-step alignment.

40. The embossing system of claim 26 having a cross-machine element engagement of greater than at least about 15 mils.

41. The embossing system of claim 26 having a cross-machine element engagement of between about 16 to 32 mils.

42. The embossing system of claim 26 wherein the cross-machine embossing elements have angled sidewalls, wherein the sidewalls have an angle of less than about 20°.

43. The embossing system of claim 26 wherein the sidewall angle of the cross-machine direction elements is less than about 17°.

44. The embossing system of claim 26 wherein the sidewall angle of the cross-machine direction elements is less than about 14°.

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~~44~~. The embossing system of claim 26 wherein the sidewall angle of the cross-machine direction elements is less than about 11°.

⁴⁶
~~45~~. The embossing system of claim 26 wherein the sidewall angle of the cross-machine embossing elements is from about 7° to 11°.

^{47,}
~~46.~~ The embossing system of claim 26 wherein at least a portion of the elements have a height of about 30 mils and have an engagement of about 15 mils.

^{48,}
~~47.~~ The embossing system of claim 26 wherein at least a portion of the elements have a height of about 30 mils and have an engagement of about 24 mils.

^{49,}
~~48.~~ An embossing system for embossing and perforating at least a portion of a web comprising:
a first embossing roll; and
at least a second embossing roll,
wherein each of the first and second embossing rolls has at least one juxtaposable embossing element defining a cross-machine direction perforate nip between the cross-machine direction elements for embossing and perforating the web, and
wherein at least a substantial portion of the cross-machine direction elements have sidewall angles of less than about 20°.

^{50,}
~~49.~~ The embossing system of claim 48 wherein the cross-machine direction elements have sidewall angles of less than about 17°.

~~50.~~^{51.} The embossing system of claim 48 wherein the cross-machine direction elements have sidewall angles of less than about 14°.

~~51.~~^{52.} The embossing system of claim 48 wherein the cross-machine direction elements have sidewall angles of from about 7° to 11°.

~~52.~~^{53.} The embossing system of claim 48 wherein the embossing elements are substantially oval shaped.

~~53.~~^{54.} The embossing system of claim 48 wherein the embossing elements are substantially hexagonal shaped.

~~54.~~^{55.} The embossing system of claim 48 wherein the embossing elements are substantially rectangular shaped.

~~55.~~^{56.} The embossing system of claim 48 wherein the cross-machine embossing elements are at an angle of from at least about 60° to 120° from the machine direction.

~~56.~~^{57.} The embossing system of claim 48 wherein the cross-machine embossing elements are at an angle of about 85° to 95° from the machine direction.

~~57.~~^{58.} The embossing system of claim 48 wherein the height of the cross-machine embossing elements is from at least about 15 mils.

~~58.~~^{59.} The embossing system of claim 48 wherein the height of the cross-machine embossing elements is from at least about 30 mils.

~~59.~~^{60.} The embossing system of claim 48 wherein the height of the cross-machine embossing elements is from about 30 to 65 mils.

~~60.~~^{61.} The embossing system of claim 48 wherein the height of the cross-machine embossing elements is at least from about 45 mils.

~~61.~~^{62.} The embossing system of claim 48 wherein the height of the cross-machine embossing elements is at least from about 60 mils.

~~62.~~^{63.} The embossing system of claim 48 wherein the cross-machine embossing elements are in full-step alignment.

~~63.~~^{64.} The embossing system of claim 48 wherein the cross-machine embossing elements are in half-step alignment.

~~65.~~
64. The embossing system of claim 48 wherein the cross-machine embossing elements are in quarter-step alignment.

~~66.~~
65. The embossing system of claim 48 having a cross-machine element engagement of from greater than about 15 mils.

~~67.~~
66. The embossing system of claim 48 having a cross-machine element engagement of at least about 16 to 32 mils.

~~68.~~
67. The embossing system of claim 48 wherein at least a portion of the elements have a height of at least about 30 mils and have an engagement of at least about 15 mils.

~~69.~~
68. The embossing system of claim 48 wherein at least a portion of the elements have a height of at least about 30 mils and have an engagement of at least about 24 mils.

~~70.~~
69. A method for embossing and perforating at least a portion of a web comprising:

providing a first embossing roll having embossing elements; and
providing at least a second embossing roll having embossing elements,
wherein at least a predominate number of the embossing elements are

substantially oriented in the cross-machine direction and wherein the first and second embossing rolls define a perforate nip for embossing and perforating the web; and

passing the web between the first and second rolls wherein the first and second embossing rolls are configured and the engagement and alignment therebetween are controlled to result in an element clearance that will achieve a non-picking clearance while achieving at least a 15% reduction in the machine direction tensile strength of the web.

~~71.~~
71. The method of claim 69 wherein the embossing elements are substantially oval shaped.

~~72.~~
72. The method of claim 69 wherein the embossing elements are substantially hexagonal shaped.

~~73.~~
73. The method of claim 69 wherein the embossing elements are substantially rectangular shaped.

~~74.~~
74. The method of claim 69 wherein the cross-machine embossing elements are at an angle of from about at least 60° to 120° from the machine direction.

75.

~~74.~~ The method of claim 70 wherein the cross-machine embossing elements are at an angle off about 85° to 95° from the machine direction.

76.

~~75.~~ The method of claim 70 wherein the height of the cross-machine embossing elements is from at least about 15 mils.

77.

~~76.~~ The method of claim 70 wherein the height of the cross-machine embossing elements is from at least about 30 mils.

78.

~~77.~~ The method of claim 70 wherein the height of the cross-machine embossing elements is from about 30 to 65 mils.

79.

~~78.~~ The method of claim 70 wherein the height of the cross-machine embossing elements is at least from about 45 mils.

80.

~~79.~~ The method of claim 70 wherein the height of the cross-machine embossing elements is at least from about 60 mils.

81.

~~80.~~ The method of claim 70 wherein the cross-machine embossing elements are in full-step alignment.

~~82.~~
81. The method of claim 70 wherein the cross-machine embossing elements are in half-step alignment.

~~83.~~
82. The method of claim 70 wherein the cross-machine embossing elements are in quarter-step alignment.

~~84.~~
83. The method of claim 70 having a cross-machine element engagement of from at least about 15 mils.

~~85.~~
84. The method of claim 70 having a cross-machine element engagement of from about 16 to 32 mils.

~~86.~~
85. The method of claim 70 wherein the cross-machine embossing elements have angled sidewalls, wherein the sidewalls have an angle of less than about 20°.

~~87.~~
86. The method of claim 70 wherein the sidewall angle of the cross-machine elements is less than about 17°.

~~88.~~
87. The method of claim 70 wherein the sidewall angle of the cross-machine elements is less than about 14°.

89.

~~88.~~ The method of claim 70 wherein the sidewall angle of the cross-machine elements is less than about 11°.

90.

~~89.~~ The method of claim 70 wherein the sidewall angle of the cross-machine embossing elements is from about 7° to 11°.

91.

~~90.~~ A method for reducing the tensile ratio of a web by embossing and perforating the web comprising:

passing a web through an embossing system, wherein the embossing system comprises a first embossing roll having embossing elements and at least a second embossing roll having embossing elements, wherein the first and second embossing rolls define a plurality of perforate nips for embossing and perforating the web; and

wherein at least a predominant number of the perforate nips are substantially oriented in the cross-machine direction.

92.

~~91.~~ The method of claim 90 wherein the tensile ratio of the web is reduced by at least 10% of the difference between the base web tensile ratio and 1.

~~93.~~
~~92.~~ The method of claim 90 wherein the tensile ratio of the web is reduced by at least 20% of the difference between the base web tensile ratio and 1.

~~94.~~
~~93.~~ The method of claim 90 wherein the tensile ratio of the web is reduced by at least 30% of the difference between the base web tensile ratio and 1.

~~95.~~
~~94.~~ The method of claim 90 wherein substantially all of the perforate nips are substantially oriented in the cross-machine direction.

~~96.~~
~~95.~~ The method of claim 90 wherein all of the perforate nips are substantially oriented in the cross-machine direction.

~~97.~~
~~96.~~ A method for reducing the tensile ratio of a web by embossing and perforating the web comprising:

passing a web through an embossing system, wherein the embossing system comprises a first embossing roll having at least one embossing element oriented substantially in the cross-machine direction and at least a second embossing roll having at least one juxtaposable embossing element oriented substantially in the cross-machine direction, thereby defining a cross-machine

direction perforate nip between the cross-machine direction elements for embossing and perforating the web; and

wherein at least a substantial portion of the cross-machine direction elements have at least the ends beveled.

98,

~~97~~. A method for reducing the tensile ratio of a web by embossing and perforating the web comprising:

passing a web through an embossing system, wherein the embossing system comprises a first embossing roll having at least one embossing element oriented substantially in the cross-machine direction and at least a second embossing roll having at least one embossing element oriented substantially in the cross-machine direction, thereby defining a cross-machine direction perforate nip between the cross-machine direction elements for embossing and perforating the web; and

wherein at least a portion of the cross-machine direction elements have cross-machine direction sidewall angles of less than about 20°.

99,

~~98~~. The method of claim 97 wherein at least a portion of the cross-machine direction elements have cross-machine direction sidewall angles of less than about 11°.

~~100.~~
99. The method of claim 97 wherein at least a portion of the cross-machine direction elements have cross-machine direction sidewall angles of from about 7° to 11°.

~~101.~~
100. A method for reducing the tensile ratio of a web by embossing and perforating the web comprising:

passing a web through an embossing system, wherein the embossing system comprises a first embossing roll having embossing elements and at least a second embossing roll having embossing elements, wherein the first and second embossing rolls define a perforate nip extending in the cross machine direction for embossing and perforating the web; and

wherein the first and second embossing rolls are configured to, and the engagement and alignment are controlled to, result in an element clearance that will achieve a non-picking clearance.

~~102.~~
101. The method of claim 69, 90, 96, 97, or 100 wherein the web is a creped web.

~~103.~~
102. The method of claim 101 wherein the web is creped with an undulatory creping blade.

~~104.~~
103. The method of claim 69, 90, 96, 97, or 100 wherein the web is calendered.

105.

~~104.~~ A perforate embossed web having a plurality of cross-machine direction oriented perforations wherein the embossed web has a tensile ratio of less than about 1.2.

106.

~~105.~~ A perforate embossed web having a transluminance ratio of at least 1.005.

107.

~~106.~~ The perforate embossed web of claim 105 having a transluminance ratio of at least 1.01.

108.

~~107.~~ A wet-laid cellulosic perforate embossed web having perforate embossments extending predominately in the cross-machine direction.

109.

~~108.~~ The wet-laid cellulosic perforate embossed web having perforate embossments extending predominately in the cross-machine direction of claim 107 wherein the perforate embossments extend in the cross-machine direction for at least about 20 mils.

110.

~~109.~~ The wet-laid cellulosic perforate embossed web having perforate embossments extending predominately in the cross-machine direction of claim 107 wherein the angle between the perforate embossments extending in the

cross-machine direction and the machine direction of the web is between 60° and 120°.

~~111~~
~~110~~. The wet-laid cellulosic perforate embossed web having perforate embossments extending predominately in the cross-machine direction of claim 107 wherein said perforate embossments extend substantially through the thickness of the web.

~~112~~
~~111~~. The wet-laid cellulosic perforate embossed web according to claim 105 having a transluminance ratio of at least 1.02.

~~113~~
~~112~~. A method of embossing and perforating the web comprising:
passing a web through an embossing system, wherein the embossing system comprises a first embossing roll having embossing elements and at least a second embossing roll having embossing elements, wherein the first and second embossing rolls define a plurality of perforate nips for embossing and perforating the web; and
wherein the tensile ratio of the web is reduced by at least about 5% of the difference between the tensile ratio of the base sheet and 1.0.

~~114~~
~~113~~. The embossing system of claim 1, 26, or 48 wherein at least a first portion of the cross-machine embossing elements are male elements having a

height of at least about 15 mils and wherein at least a second portion of the cross-machine embossing elements are male elements having a height of at least about 15 mils and wherein the height of the second portion elements is greater than that of the first portion elements.